An Interface Design for Urban Recreational Walking: A Practice-Based Case Study

1. Introduction

Over the last decade, the potential of digital wayfinding has opened up whole new areas of research. Numerous studies have looked at how, for example, dynamic signage might offer directional information (e.g., Kray, Kortuem and Krüger 2005; Langner and Kray 2011; Taher and Cheverst 2011); how digital platforms might support those with blindness or visual impairment (e.g., Giudice and Legge, 2008; Hesch and Roumeliotis 2010; Sáenz and Sánchez 2010); and how handheld, multimodal visitor guides may enrich the museum experience (e.g. Wakkary and Hatala 2007; van Hage, Stash, Wang, and Aroyo 2010; Walker 2010; Fontaine 2014).

This study, however, directs its focus towards the visual design of GPS-enabled mobile maps; an area which is seen to have evolved in parallel with advances in handheld, mobile technology. From the simple, early prototypes, which were constrained by basic displays and limited data coverage (e.g., Kreller, Carrega, Shankar, Salmon, Böttger, and Kassing, 1998; Gartner and Uhlirz 2001) a majority of us now have constant access to richly textured representations of our location. As progress has been made, a tentative body of literature attending to an array of practical and theoretical issues in this area has begun to emerge (e.g. Meng, Zipf and Reichenbacher 2005; Fraser Taylor and Caquard 2006; Cartwright, Peterson and Gartner 2008; Gartner 2008; Huang and Gartner 2010). Equally, experimental work is ongoing (Porathe 2008; Oksanen, Halkosaari, Sarjakoski and Sarjakoski, 2014). However, due the immaturity of the field, it can be argued that much remains unexplored.

In one area of work, some are questioning conventional approaches to the visual design of GPS-enabled mobile interfaces. For example, studies have investigated the potential of adaptive visualisation (e.g., Reichenbacher 2004); alternative modes of representation focused on the user's position (e.g., Zipf and Richter 2002; Meng 2005); and landmark representation (e.g., Elias and Paelke 2005). The assumptions surrounding the use of such products have also received attention, with a number of studies arguing that current interface designs can negatively impact on our spatial knowledge acquisition (e.g., Willis, Hölscher, Wilbertz and Li, 2009; Speake 2015). More particularly, in recent years, the effect of such maps on tourist experiences has begun to draw commentary (e.g., Wang, Park and Fesenmaier 2012; Mollerup 2013). Here, it has been suggested that tourists and other recreational users could benefit from novel visual approaches to interface designs, i.e., approaches which do not employ conventional, totalized cartographic representations of space (Brown and Chalmers 2003). However, little work appears to have been done on this. Accordingly, picking up on these themes, the present study explored the possibility of developing a novel GPS-enabled mobile map interface for urban walkers, looking, in particular, at recreational walking.

As design practice was central to the conduct of research, the study is defined as practice-based (Candy 2006). While, many recent contributors have sought to clarify the methodological scope of such an approach (e.g., Frayling 1993; Archer 1995; Zimmerman and Forlizzi 2008), it is generally agreed that practice-based researchers tend to focus on the *construction* of artefacts and scenarios (Koskinen, Zimmerman, Binder, Redström & Wensveen 2011). Though the value and validity of such work has been questioned (e.g., Cross 1999; Friedman 2003), many accept that the approach may yield useful conclusions for practice (e.g., Archer 1995; Gaver 2012) and potentially lead to theoretical contributions both *for* and *about* design, including implications and frameworks (e.g., Dourish 2006; Zimmerman, Stolterman and Forlizzi 2010).

Accordingly, the primary motivation of the present study was to develop an initial basic interface design that might, in turn, inform future designs and, as such, open up further practical and theoretical possibilities. Consequently, the structuring of the method is seen as an outcome of the study, offering an example of how practice-based research may proceed in the context of information design.

2. Method

The study followed a mixed methods approach, involving two phases of work wherein both qualitative and quantitative methods of data collection and analysis were applied (e.g., Tashakkori and Teddlie 1998; Creswell and Plano

Clark 2011). In the first phase, a program of contextual interviews was conducted with urban walkers. In the second a working prototype was developed and tested.

2.1 Phase One: Contextual Interviews

Throughout the contextual interviews, a purposive sampling strategy (Bryman 2008, p. 418) was applied. Participants were recruited, based on four criteria:

- A definite interest in the activity of urban recreational walking;
- Regularly engaging in the activity for the purposes of recreation alone (i.e., at least once a month);
- Long-term experience of the activity (i.e., more than one year);
- Experience of using GPS-enabled technology.

Participants were recruited through social media, student groups, and personal recommendations. While interviewing this initial group, a technique known as *snowball sampling* (ibid, p. 202) was also introduced. Here, interviewees were asked to suggest other potential participants. This technique allowed for the recruitment of a larger participant group than might otherwise have been possible. It also meant that it was more likely that potential participants would meet the above criteria. In the end, a total of 31 individuals recruited. Most were frequent walkers, based in Britain and Ireland and aged 25–34. This focus on younger individuals reflected higher technology use among this age category.

In the interviews, focus was directed towards participants' motivations to walk, their wayfinding practices, as well as their use of wayfinding materials in general and GPS-enabled technology in particular. With regard to the latter, attention was paid to ways in which GPS-enabled mobile maps were negatively perceived. The interview data was analyzed through an interpretive phenomenological approach (e.g., Smith; 2008; Smith, Flowers and Larkin, 2009), based largely on Heidegger's hermeneutic philosophy (e.g., Heidegger 2010). In its application, participants' accounts of their experiences were examined from both an empathic, as well as a critical, perspective (Smith 2008,

p. 53). Thereafter, as in standard thematic analysis (e.g., Braun and Clarke 2006), a set of basic themes were developed and refined. These basic themes were then aggregated under broader, superordinate themes, providing a general overview of the data. From this analysis, the study's aim and general design goals were specified.

2.2 Phase Two: The Development of the Prototype

The study's aim and design goals informed an iterative design process through the second phase. This process concluded with the development of a mixed fidelity working prototype (Lim, Stolterman, and Tenenberg 2008), which was then evaluated in a final test. This test was devised based on the study's aim (see Section 3).

2.2.1 The Evaluation Participant Group. For the purposes of evaluation, a new participant group was assembled. This group was not informed of the study's aim. As in the contextual interviews, recruitment was first based on purposive sampling and, thereafter, on snowball sampling. The same recruitment criteria also applied (see Section 2.2). In total 20 participants were recruited. Again, the majority were frequent walkers, based in Britain and Ireland and aged 25–34. Across the group, levels of familiarity with the test-route were variable.

2.2.2 The Evaluation. The evaluation was based on a test involving two parts. In the first part, participants were issued with a brief orientation task using a conventional GPS-enabled mobile map (i.e. Google Maps). In the second part, they were asked to walk a short, pre-defined route and to use the prototype at least twice. In both parts, as a means of observing behaviors, participants were recorded. Results from the orientation task were compared to those obtained for participants' first use of the prototype along the test route. Additionally, immediately after the test, each participant was briefly interviewed in order to gain an insight into their experience of using both interfaces.

As the framing of the evaluation was contingent on the consolidation of the study's aim—defined in phase one—further contextual details will be specified in Section 6.1.

3. Contextual Interview Results

With regard to participants' motivations to engage in urban walking, two broad themes were seen to emerge: *intrinsic* motivations and *extrinsic* motivations. Intrinsic motivations were seen to refer to forms of experience only available in walking, i.e. no other activity could satisfactorily replace the walk. Conversely, extrinsic motivations referred to benefits that could be accrued through the act of walking but were also available in other forms of experience.

Across the group, a majority were seen to hold strong intrinsic motivations. For the most part, these were associated with how participants were able to relate to their surroundings in unique ways while walking recreationally. Many spoke of exploring, discovering and seeing the city as walkers. Several also claimed to directly value the immediate experience of walking. Though less emphasis was placed on extrinsic motivations, many participants mentioned that walking provided them with an opportunity to exercise as well as socialize.

In questioning participants regarding their use of GPS-enabled mobile maps a majority claimed to use the technology while walking recreationally. Many, however, stated that they did not. Some simply did not own a smartphone. Others, however, held particular reservations regarding the use of GPS-enabled mobile maps, with a number taking the view that the technology would undermine their walking experience.

Among those who did use GPS-enabled mobile maps, several primary usage strategies were identified. Most claimed to use mobile maps to orientate themselves and gain an understanding of 'where' they were. In the main, 'where' was associated with broad *generality* as opposed to exacting specificity. As one participant put it: "That's really all I would use it for, just [to] give [me] a general sense of where I would be going through or near". Beyond orientation, several participants spoke of using mobile maps to plan, navigate, and check their route. In contrast to those who prioritized orientation, these participants sought specific, highly detailed information.

In describing the positives and negatives of their experience of mobile map use, most participants offered relatively balanced appraisals; approving at the same time as criticizing. In terms of positives, many spoke of the technology's constant availability and the sense of security it provided. With the negative aspects, two key issues were seen to emerge. Firstly, a large portion of participants felt that mobile map use undermined their awareness of the features of the immediate environment, with the technology requiring too much of their attention. Secondly, a similar number felt that mobile maps disrupted the experience of exploration and discovery, embedded within the their urban walking.

By linking up each participant's set of responses and arranging these next to one another, it was possible to examine the particularities of each case, as well as look for commonalities across cases. A review of the data revealed that those who held strong intrinsic motivations also appeared to feel strongly about the negative aspects associated with mobile maps identified above. Indeed, because of these negatives aspects, some participants chose to avoid the technology entirely. As with the group as a whole, if these participants did use mobile maps, they prioritized orientation over navigation or checking.

In making these observations, it was possible to move to specify the study's aim as follows:

> to develop a visual interface for intrinsically motivated urban walkers, which promoted a higher degree of awareness of the surrounding environment, at the same time as allowing for the experience of exploration.

Leading on from this and reflecting further on the interview findings, a set of general design goals were also specified. These goals stated that, ideally, a final interface would:

- Support orientation over navigation;
- Direct attention to environmental features, addressing the issue of mobile maps undermining the user's awareness of the surrounding environment;
- Minimize levels of content and interactivity, allowing users to focus

more on the surrounding environment as well as explore/discover in their own terms.

4. The Design Process

4.1 The Initial Design Decisions

Initiating the second phase of the research in response to the study's aim and design goals, a large body of thumbnail sketches were produced. These were kept "intentionally ambiguous" (Buxton 2007, p. 113) allowing for interpretation and adaptation through iteration. Gradually, focus was directed towards what came to be seen as the elemental components of GPS-enabled interfaces: the representation of space; the representation of specific sites (e.g., landmarks); the representation of the user's location; and the representation of routes. As work progressed, potentially valuable approaches were identified and reapplied. Over time, four key visual design strategies were seen to emerge:

- Distorting the spatial representation;
- Including landmark symbols;
- Including a you-are-here symbol;
- Eliminating streets and roads.

The potential scope of each of the strategies was then explored in a series of static interface mock-ups. Three separate groups of mocked-up interface designs were developed (see Figure 1). In one grouping possible approaches to distorting the geographic representation were considered; another landmarks; and, a final one, the you-are-here symbol. Streets and roads were excluded in all cases.

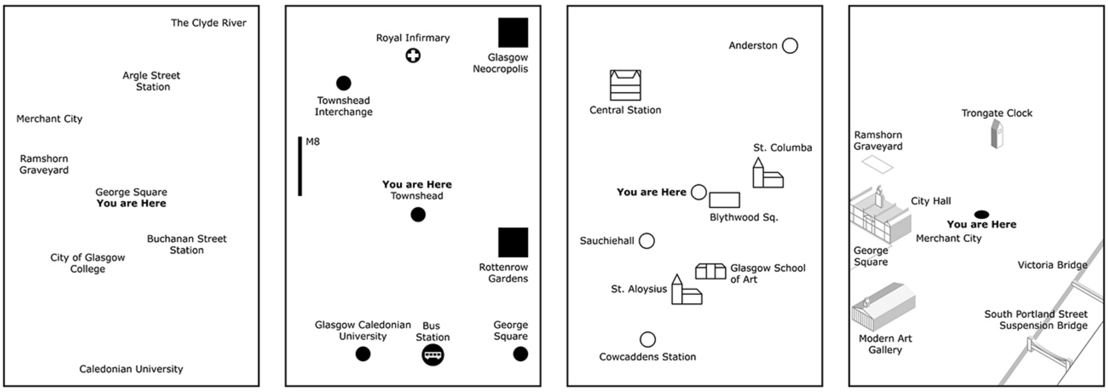

Figure 1. A series of early designs exploring strategies for representing landmarks. The options range from abstract text through to 3D isometric.

Once complete, each grouping was examined by the researcher as a unit. This allowed for the consideration of alternatives set next to one another. Selections were then made based on which approach was seen to hold the most potential within a given visual strategy. These were as follows:

- A *circular* distortion of the user's location;
- Simple, 2D landmarks;
- A *large* you-are-here symbol.

Table 1 presents the rationale for the above selections.

Table 1 The Rationale for the Selection of Particular Approaches within the Visual Interface

Selected Approach in Each Strategy	Reasons for the Selection	Possible Alignment with the Design Goals	Reasons for the Rejection of Other Options
A circular distortion of the user's location	This approach was seen to appropriately privilege the user's position at the same time as offer a sense of the surrounding environment.	The view was taken that approach could effectively support the user to orientate in relation to the surrounding environment.	Other possibilities tended focus on a linear representation of geographic features, based on the walker's forward path. These were seen as limited in that the areas to the right, left and back of the walker were not represented. Equally, the technical feasibility of these options was also in doubt.

Simple, 2D landmarks	This approach was seen to allow for a minimal, yet sufficient, level of representational detail.	The view was taken that the inclusion of simple landmark symbols could encourage users to relate to the features of the surrounding environment, without significant cognitive effort.	The more realistic approaches (e.g., isometric buildings) were seen as unnecessarily detailed and possibly confusing. Further, the less realistic approaches bore no relation to the environmental features they represented.
A large you-are-here symbol	This approach was seen as highly impactful and instantly accessible. It was felt that it offered the most potential in supporting orientation.	The view was taken that a large you-are-here symbol could support users to orientate when set against other interface features (i.e., landmarks).	It was felt that other approaches lacked the same clarity, visibility and impact.

From the above, consideration was given to identifying a test platform. Based on its general popularity at the time of the research, the Apple iPhone 4S was eventually selected. In terms of technical specifications, the 4S has a touchscreen display measuring 640 pixels (px) wide by 960px high, and a resolution of 32px per inch (ppi). It also affords a number of sensors, including a magnetometer, a three-axis gyroscope, and an assisted GPS (AGPS) receiver (Apple 2012). By combining data from these three sources it was possible to produce an interface, which could simultaneously reference the device's orientation, its movements along a 3D axis, as well as its geographic coordinates.

4.2 The Iterative Design Cycle

With the test platform in place, an iterative design cycle was launched. Based on informal testing with participants in a number of field settings, seven low-fidelity interfaces were developed in sequence (see, for example, Figure 2). Drawing on data from the 4S's sensors, each interface was programmed to *rotate* in accordance with the orientation of the device. This allowed onscreen design features to hold alignment with real-world locations.

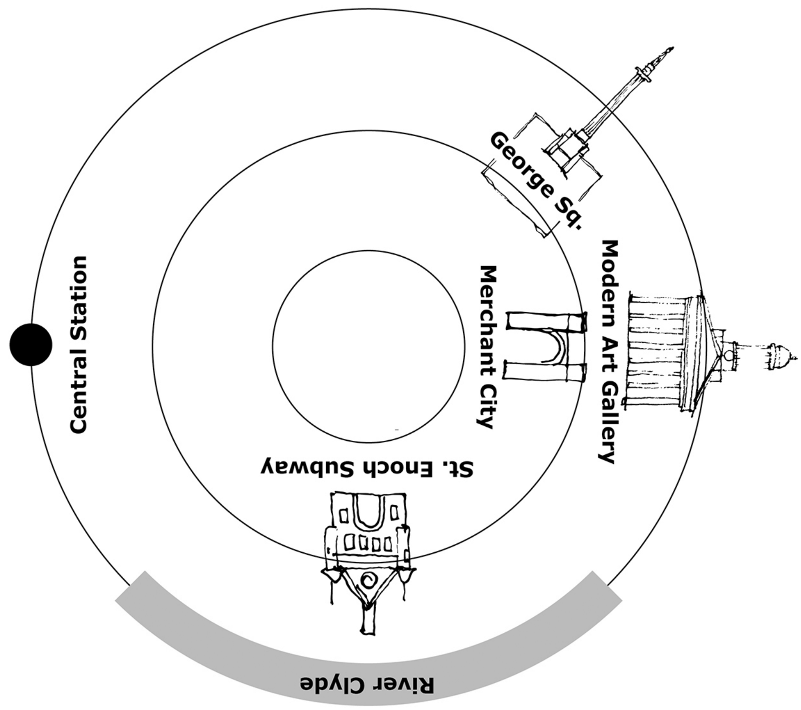

Figure 2. The first low-fidelity interface produced for a field setting in central Glasgow. In this early design, not all of the landmarks represented were visible to participants.

In testing, participants were presented with the low-fidelity interface and asked to describe what was “around” them based on the information presented on screen. When they finished, they were also asked to openly evaluate the interface’s visual design. Throughout, attention was paid to their general behaviours, in particular to where they looked and how they moved.

Through this testing process, progressive adaptations were made to the overall visual approach. While most adaptations were minor, the following adjustments can be considered significant in terms of their impact on the interface as a whole:

- After the first interface test, as a result of participants’ negative feedback, it was decided that landmark symbols would only appear onscreen when the physical landmark was also immediately visible to the user;
- After the first interface, as a result of participants’ suggestions, journey

times to landmarks/city districts were included within the interface;

- In the fourth iteration, triangle symbols were introduced as a means of identifying and highlighting the direction of particular landmarks, city districts and parks
- In the fourth iteration, an effort was made to differentiate between near and far, by placing 'far' features at the edge of the interface and 'near' features closer to the center;
- In the fifth iteration, wedge-shaped symbols were introduced to identify and highlight the direction of city districts;
- In the sixth iteration, as a result of participants' negative feedback, it was decided to enlarge the you-are-here symbol.

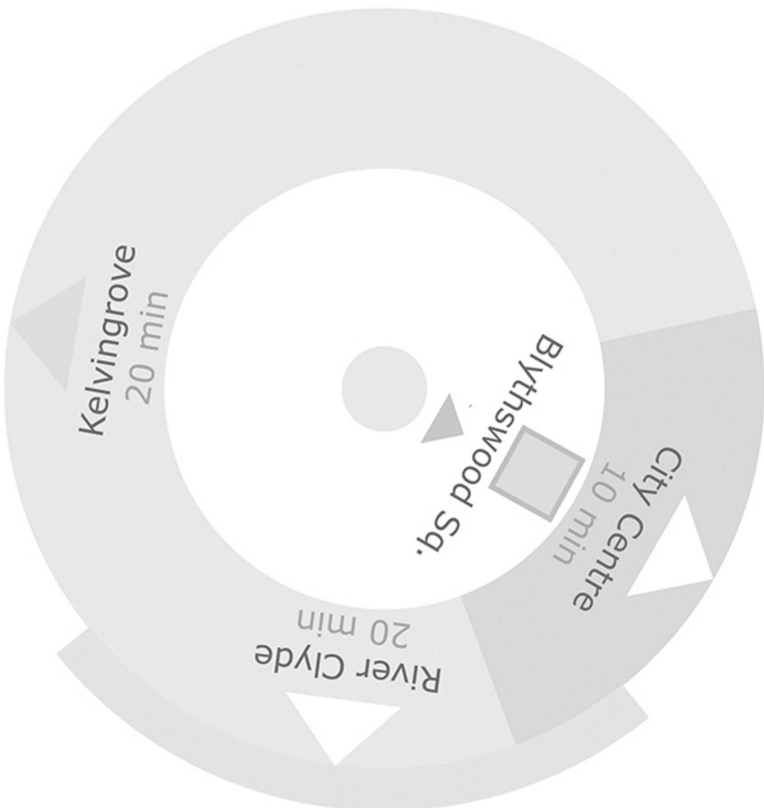

Figure 3. The fifth low-fidelity interface produced for a field setting in central Glasgow. The use of triangles to indication the general directions of landmarks appeared to work successfully, as did the use of wedge shapes for districts (e.g. the city center).

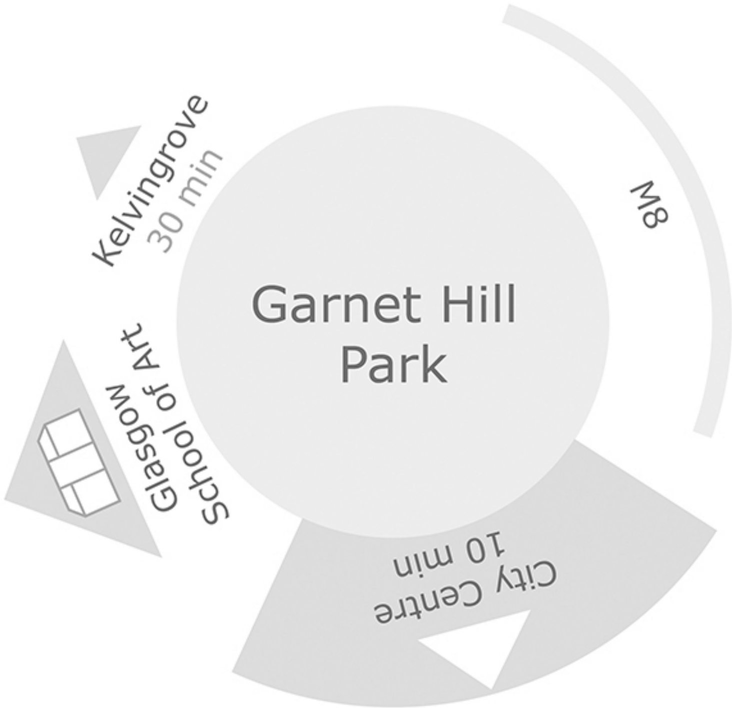

Figure 4. The seventh low-fidelity interface produced for a field setting in Glasgow. The central circle represents the location of the user. Wedge shapes still represent districts. Landmark symbols have been incorporated into triangles to indicate the direction of specific landmarks.

After the seventh iteration, reflecting back on the process as a whole, three broad observations were made. Firstly, most participants claimed to appreciate key interface features such as its direction-based approach to spatial representation, as well as its emphasis on cultural and geographic landmarks. Though a small number of participants objected to the lack of streets and roads, further discussion revealed that these individuals held a preference for highly-specific, precise geographic information. As such, they fell outside the target user-group (i.e., intrinsically motivated walkers who use mobile maps to gain a *general* sense of orientation). Secondly, in observing participants' behaviors, it was found that most looked up from the interface and turned their bodies as they responded to the researcher's task. This was viewed positively, as it suggested that these individuals were drawing conceptual associations between the interface and their surrounding environment. Thirdly, in reviewing all the designs as a sequence, it appeared that the visual structure of the interface had begun to cohere and consolidate. In the last field test, participants appeared to complete the task with particular ease and, equally, were unable to identify any problematic aspects.

On the basis of these observations, it appeared that a satisfactory level of refinement had been achieved.

5. Developing a Mixed-Fidelity Prototype

From the iterative design cycle, a mixed-fidelity working prototype was developed. The term "mixed fidelity" here refers to a design, which may be seen to demonstrate both *high*-fidelity and *low*-fidelity features simultaneously. Thus, in line with the scope of the research, the prototype's *visual* features were rendered in relative *high*-fidelity, while its dynamic and interactive aspects remained *low*-fidelity. This follows the recommendation of Lim et al. (2008), who argue that a prototype should act as a "manifestation that, in its simplest form, filters the qualities in which the designers are interested, without distorting the understanding of the whole" (p.1).

In moving to design the prototype, a test-route was first selected: a riverside path, approximately one kilometer in length, passing through a large park in the city of Glasgow, UK. This selection was made on the basis that it presented a clearly defined test space and brought the walker into proximity with many high-profile local landmarks including a museum, a university campus, and a river.

From this, a number of site visits were made. The visits allowed for the identification and selection of salient cultural and environmental features along the route. Here, Kevin Lynch's system of "elements" of the city image, i.e. paths, edges, nodes, districts and landmarks (1960, p. 46), was employed as a framework for directing the interpretive process. In the end, a final master list of the route's key features was developed as means of defining the content for the final design.

With the content defined, consideration was given to the prototype's technical architecture. Due to the researcher's skills set, it was decided that all dynamic and interactive features would be enabled through a combination of HTML 5, CSS and JavaScript. Here, it was envisaged that the prototype would be presented on a single webpage containing a single button. By pressing this button, the site would query the device's coordinates and compare this data to a pre-defined array of possible coordinates. If a positive match was made, then a location-specific image, i.e. the interface, would be downloaded and appear on screen. As with the low-fidelity designs, it was also intended that this image would be programmed to *rotate* in accordance with data drawn from the device's sensors.

Taking this approach, it was necessary to develop a set of unique interface *images*, which could then be downloaded and appear onscreen at particular locations along the route. To enable this, the test-route was divided into a sequence of nine distinct sections extending for a minimum of 10 meters and a maximum of 80 meters. These sections were defined as distinct on the basis that each was seen to offer an enclosed "vista", i.e. a unique, contained line of sight (Gibson 1986, p. 198). From this, the relations between each section and the route's key features were then defined through onsite data collection with a digital compass. Here, the degrees at which each relevant landmark, edge or district was positioned were logged, allowing for the eventual development of nine unique, section-based spatial representations.

The final prototype appeared on a single webpage, with a single button reading "Map Me". On pressing the button, a unique, location-specific, rotating representation appeared on screen. As the user moved along the route, it was possible to refresh the webpage and, accordingly, download a new location-specific representation, which rotated as the device was adjusted left or right, up or down. Figure 5 provides an overview of the interactive process. Figures 6 and 7 demonstrate the prototype in-situ. Additionally, table 2 sets out the prototype's key characteristics as compared with the last low-fidelity interface.

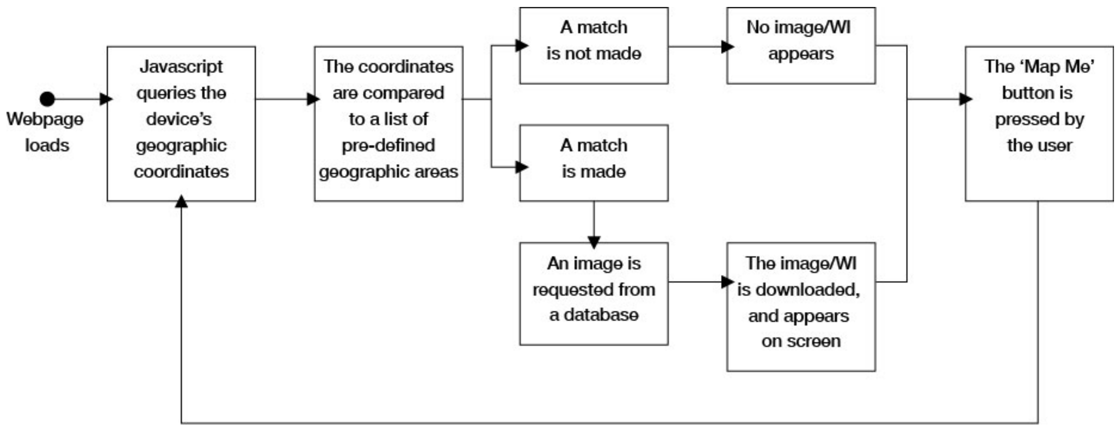

Figure 5. An overview of the prototype's interactive process.

Figure 6. The prototype interface in situ, with Glasgow University in the distance.

Figure 7. The prototype interface in situ, at the end of the test-route.

Table 2 An Overview of the Decisions taken in Relation to Particular Features in the Design of the Final Prototype

Interface Design Feature(s)	Approach Taken	Decision Made in Relation to the Prior Iteration of the Interface
Approach to Spatial Representation	A circular distortion of the user's location is applied. No true distances are represented. The screen space is divided into 'here', 'near' and 'far'.	There was no 'near' space in the last iteration. It was posited that the addition of a dedicated space for 'near' features would render apparent the distinction between near and far in the representation.
You-are-Here Symbols	A large circular representation appears in the center of the screen.	The symbol is slightly smaller than the last iteration to allow for more space on screen for the representation of 'near' features (see above).
Landmark Symbols	Flat 2D representations and abstract triangles are applied for visible landmarks. Words and abstract triangles are applied for non-visible landmarks (i.e. landmarks that the walker can't see).	A similar approach had been taken in the last iteration, as this had appeared to function successfully.
District Symbols	Districts are represented by wedge-shapes containing text and a triangle. These appear at the outer edge of the interface (i.e. they are denoted as being 'far').	Wedge-shapes were used to denote districts in the previous three iterations. There had been no objections to this approach, and so it was reapplied.
Journey Times	The time to districts was contained	This approach had been applied in

Interface Design Feature(s)	Approach Taken	Decision Made in Relation to the Prior Iteration of the Interface
	in the district shapes.	the last four iterations and participants had claimed to find it useful.

6. *The Prototype Evaluation*

6.1 Framing the Details of the Tasks, Observations and Interview Questions

The evaluation tasks and interview questions were devised in relation to the study's aim (see Section 3).

In the first task, for a period of just over 1 minute, individuals were asked to use a conventional interface (i.e., Google Maps) to describe what was "around" them. No restriction was placed on where they directed their gaze. If participants asked for clarification on this matter, they were told that there were no expectations regarding their behavior. Following on, in the second task, participants were presented with the prototype and given a minute to examine the design, thus allowing them to gain an initial familiarity with its features. They were then asked to use the prototype at least twice as they walked along the test-route (see Section 5). Use was here presented as pressing the "Map Me" on the prototype's webpage. It was thereby intended that participants would see at least two separate spatial representations (i.e., interface images) at two separate locations, and, as such, experience these representations in-situ.

In the observation of participants' behavior, the researcher attended to the *amount* of times participants looked up from each interface (i.e. the frequency). Each participants' use of the conventional interface was compared to their *first use* of the prototype. Focus was directed to the first use on the basis that—at this point—participants were likely to be as self-conscious as they had been when looking at the conventional interface and, so, as affected in their behavior. Accordingly, each participant's first use of the prototype was identified and isolated in the video recordings. From this, the results obtained for the conventional interface were compared to those for the prototype; thus affording an insight into the extent to which the prototype may have supported a higher degree of awareness of the surrounding environment (as per the study's aim).

In the interviews at the end of the test route, focus was directed towards participants' experience of the prototype, how it compared to the conventional interface, and its perceived value. Accordingly, the following participant-centered questions were formulated:

- What happened when you used the app?
- What is the app like compared to the first interface?
- Can you imagine a situation where the app could be useful?

As in the contextual interviews of the first phase of the research, interpretive phenomenological analysis was again applied in analysis of the post-test interview data. These results were seen to offer a first-hand insight into whether the prototype supported a higher degree of awareness of the surrounding environment, at the same time as allowing for the experience of exploration (again, as per the study's aim).

6.2 The Observation Results

Table 3 presents the results of the observations as well as the comparison between participants' performance in both tasks. We may observe a notable divergence in participants' behaviors (i.e. in their use of the conventional interface and the prototype).

Table 3 Variation in Participants' Behaviour When Using The Conventional Interface and the Prototype

Evaluation Participant No.	Frequency of Upward Glances/Gazes		Variation Results in Relation to the Prototype Interface
	The Conventional Interface	Prototype	
1	0	1	+1
2	0	6	+6
3	1	7	+6
4	0	1	+1

Evaluation Participant No.	Frequency of Upward Glances/Gazes		Variation Results in Relation to the Prototype Interface
	The Conventional Interface	Prototype	
5	0	8	+8
6	0	2	+2
7	7	3	-4
8	0	7	+7
9	0	5	+5
10	2	3	+1
11	0	11	+11
12	1	7	+6
13	4	11	+7
14	1	12	+11
15	0	8	+8
16	6	6	+0
17	0	7	+7
18	4	9	+5
19	0	5	+5
20	5	6	+1
	Median Value	Median Value	Median Value Derived
	0	6.5	+5.5

Turning to the *frequency* of participants' upward glances/gazes with the conventional interface, we see that 11 (of 20) participants did not look up at the surrounding environment with the conventional interface. Those who did look up, did so a minimum of 1 time and maximum of 7 times. Here, a median value of 0 upward glances/gazes is derived.

With the prototype, 20 (of 20) participants looked up at least 1 time during this minute sample of their use. The maximum number of upward glances/gazes was 12. Here, a median value of 6.5 upward glances/gazes is derived.

When directly comparing the frequency of participants' upward glances/gazes in both parts of the test through variance analysis, we find that a median value of 5.5 *additional* glances/glazes have been observed in participants' use of the prototype. Indeed, surveying each case of paired values, it is found that 16 (of 20) participants looked up at least *twice as much* while using the prototype as compared to the conventional interface.

6.3 Post-Test Interview Results

In discussing their experience of prototype, most participants spoke of how the interface either highlighted or drew their attention to features in the surrounding environment. For some, this was simply a matter of finding a name ascribed to a structure already within their view, e.g., a fountain. For others, the interface was found to be highly directive. As one participant put it: "You look this way and that's where the thing is." Somewhat surprisingly, some appeared to find a special value in this guidance. For example, one participant claimed that it made him aware of "what was worth looking at" (this is considered in Section 9).

When participants were asked to compare the prototype to the conventional interface, all were able to draw clear distinctions between the two interfaces. Across the group, two key superordinate themes were seen to emerge, *environmentally-focused understandings* and *interface-focused understandings*. In taking an *environmental focus*, participants tended to place emphasis on how the interface related to the environment. For the most part, this theme emerged in reference to the prototype, with participants often noting how its visual interface highlighted immediate physical features, emphasized directions or privileged their position in relation to other elements.

Conversely, in taking an *interface focus* participants spoke of the interface almost exclusively in terms of its visual or interactive aspects. For the most part, this theme emerged in reference to the conventional interface, which was often described as route-based and graphically dense (i.e., presenting a complex visual representation).

With regard to the value of the prototype, all participants were able to envisage reasonably well-defined scenarios of use. Again, two superordinate themes were seen to emerge, usage in *immersive* situations and usage in *prosaic* situations. Most envisaged usage in immersive situations, with a general emphasis being placed on the individual's involvement in their surroundings during use. For example, some spoke of how, through exploration or wandering, the prototype might be used to undertake a tour of an unfamiliar environment. As one participant speculated, it would allow them to "look for what you couldn't see on the map".

Conversely, with the less prominent theme of usage in *prosaic* situations, it was not apparent that the user would be keenly aware of the surrounding environment or their embodied involvement in it. In these accounts, emphasis was generally placed on routine tasks such as general wayfinding and navigation, highlighting functionality over any emotional or esthetic possibilities.

6.4 Discussion

This study aimed to produce an interface for intrinsically motivated urban recreational walkers, which promoted a higher degree of awareness of the surrounding environment, at the same time as allowing for the experience of exploration (see Section 3).

Reviewing the results, it is possible to make a number of observations. Firstly, with the prototype, a majority of the group looked up frequently from the screen and claimed to have engaged in some way with the environmental features. Further, when considering the possible value of the prototype, many envisaged highly-immersive scenarios of use such as touring through exploration and wandering. With the conventional interface, a majority did not look up from the screen and spoke of its design in isolation from the environment, i.e., offered an interface-focused understanding. Therefore, in comparing participants' pattern of behaviors with the conventional interface to those with the prototype, it may be that the prototype supported higher levels of meaningful engagement with the environment for a majority of the group. Further, as a majority were able to envisage appropriate scenarios of use, it appears that, at a basic level, the interface was understood and may be potentially viable.

Consequently, not withstanding the prototype's lack of refinement, it is possible to claim that its interface design appears to have met the underlying aim of the study. Equally, in the context of urban recreational walking, it may also be said to present an alternative to conventional interface design approaches, which, through further development, may allow for richer recreational experiences.

7. Conclusion

This study is seen to contribute to information design in three ways. Firstly, it provides a prototypic example of how an interface might be designed to meet the needs of urban recreational walkers. This example presents a shift away from conventional, totalized cartographic representations of space, as called for by Brown and Chalmers (2003). Secondly, following on from other work (e.g., Wang, Park and Fesenmaier 2012; Mollerup 2013), the results of the contextual interviews offer further insight into the complex relationship between GPS-enabled technology and recreational experiences. Thirdly, as this is a practice-based study it has been necessary to strike a balance between the demands of formal research on the one hand and practical work on the other. It is hoped that techniques employed throughout—whether relating to participant recruitment, contextual research, iterative design, prototype development or evaluation—may inform and guide the work of future researchers in the field.

8. Limitations

While the results obtained are promising, it must be borne in mind that as a single case study, with a small number of participants mainly aged between 25–34, no generalizations can be drawn from the results. It must also be stressed that the comparison of results in evaluation only *suggests* that the prototype *may* have supported higher levels of meaningful engagement. No firm inferences can be drawn. There are a number of reasons for this. For example, participants' behavior may have been affected by the different locations of tasks, or that the researcher was present as they used the conventional interface but not the prototype.

Finally, as this a mixed-fidelity prototype, much technical work is still required before a more robust, wide-ranging system can be delivered. This would demand significant investment, not to mention the dedicated attention of a highly ambitious, multi-disciplinary team. However, based on this early work, it appears that any outcome would have beneficial implications for the practice of urban recreational walking and indeed, more generally, for urban tourism as a whole.

9. Future Work

Leading on from this study, two recommendations for future work are made. Firstly, it is recommended that future designs focus explicitly on the possibility of embedding directionality in a mapping interface in order to support a user's awareness of the surrounding environment. Secondly, based on the observation that some participants saw value in the inclusion of certain features, it is also recommended that the possibility of allowing users to filter the type and levels of content be considered. This would enhance their ability to explore on their own terms. Beyond the above, other approaches to the visual design of GPS-enabled mobile maps—moving beyond directionality—might be proposed, along with other areas of application, e.g., running or cycling.

References

Archer, B. (1995). The Nature of Research. *Co-Design,* 2(11), 6-13.

Apple (2012). iPhone 4 - Technical Specifications. Web. <https://support.apple.com/kb/SP587?locale=en_US>

Braun, V., & Clarke V. (2006). Using Thematic Analysis in Psychology. *Qualitative Research in Psychology*, 3(2), 77–101.

Brown, B., & Chalmers, M., 2003. Tourism and mobile technology. In Kuutti, K., & Karsten, E.H., (Eds.), *ECSCW 2003: Proceedings of the Eighth European Conference on Computer Supported Cooperative Work*, Helsinki, Finland. Dordrecht: Klewer Academic Press.

Bryman, A. (2008). *Social Research Methods*, 4th Edition. Oxford: Oxford University Press.

Buxton, B. (2007). *Sketching User Experiences: Getting the design right and the right design: getting the design right and the right desig*n. San Francisco:

Morgan Kaufmann.

Candy, L., (2006). *Practice Based Research: A Guide*, *Report from Creativity and Cognition Studios*. Sydney: Sydney University of Technology.

Cartwright, W., Peterson, M., & Gartner, G. (2008). *Multimedia Cartography*, 2nd Edition. Berlin: Springer.

Cheng, K., & Pérez-Kriz, S. (2014). Map Design for Complex Architecture: A User Study of Maps & Wayfinding. *Visible Language*, 48(2), 6-33.

Cross, N. (1999). Design Research: A Disciplined Conversation. *Design Issues*, 15(2), 5-10.

Creswell, J., & Plano Clark, V. (2011), *Designing and Conducting Mixed Methods Research,* 2nd Edition*.* London: Sage.

Dourish, P. (2006). Implications for design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. New York: ACM.

Elias, B., & Paelke, V. (2005). User-Centred Design of Landmark Visualizations. In Meng, L., Zipf, A., & Winter, S., (Eds.), *Map-based Mobile Services*. Berlin: Springer.

Fontaine, L., (2014). Learning Design Thinking by Designing Learning Experiences: A Case Study in the Development of Strategic Thinking Skills through the Design of Interactive Museum Exhibitions. *Visible Language*, 48(2), 48-70.

Frayling, C. (1993). Research in Art and Design *Royal College of Art, Research Papers*, 1(1), 1-5.

Fraser Taylor, D.R., & Caquard, S., (2006). Cybercartography: maps and mapping in the information era. *Cartographica: The International Journal for Geographic Information and Geovisualization*. 41(1), 1-6.

Friedman, K. (2003). Theory Construction in Design Research: Criteria: Approaches, and Methods *Design Issues*, 24(6), 507-512.

Gartner, G. (2008). "Development of Multimedia — Mobile and Ubiquitous." In Cartwright, W., Peterson, M., & Gartner, G. (Eds.), *Multimedia Cartography*, 2nd Edition, 51-62. Berlin: Springer.

Gartner, G., & Uhlirz, S. (2001). Cartographic Concepts for Realizing a Location Based UMTS Service: Vienna City Guide "Lol@". In *Mapping the 21st Century – Proceedings of the 20th ICC*, Beijing: 2001.

Gaver, W. (2012). What should we expect from research through design? In *Proceedings of the SIGCHI conference on human factors in computing systems*. New York: ACM.

Gibson, J.J. (1986). *The Ecological Approach to Visual Perception*. New York: Psychology Press.

Giudice, N.A., & Legge, G.E. (2008). Blind navigation and the role of technology. In Helal, A., Mokhtari, M., & Abdulrazak, B., (Eds.), *Engineering Handbook of Smart Technology for Aging, Disability, and Independence,* 479-500. New York: John Wiley and Sons.

Heidegger, M. (2010). *Being and Time*. Albany: State University of New York Press.

Hesch, J.A., & Roumeliotis, S. (2010). Design and analysis of a portable indoor localization aid for the visually impaired. *The International Journal of Robotics Research*. 29(11), 1400-1415.

Huang, H., & Gartner, G. (2010). A Survey of Mobile Indoor Navigation Systems. In G. Gartner & F. Ortag, (Eds.), *Cartography in Central and Eastern Europe. Lecture Notes in Geoinformation and Cartography*. Berlin/Heidelberg: Springer.

Koskinen, I., Zimmerman, J., Binder, T., Redström, J., & Wensveen, S. (2011). *Design Research through Practice – From the Lab, Field, and Showroom*. Burlington, MA: Morgan Kaufmann.

Kray, C., Kortuem, G., & Krüger, A. (2005). Adaptive navigation support with public displays. In *Proceedings of the 10th international conference on Intelligent user interfaces.* New York: ACM.

Kreller, B., Carrega, D., Shankar, J. P., Salmon, P., Böttger, S., & Kassing, T. (1998). A Mobile-Aware City Guide Application. In *ACTS Mobile Communication Summit* 1998, Rhodes, Greece, 9th-11th June 1998.

Langner, N., & Kray, C. (2014). Assessing the Impact of Dynamic Public Signage on Mass Evacuation. In Proceedings of The International Symposium on Pervasive Displays. New York: ACM.

Lim, Y.K., Stolterman, E., & Tenenberg, J. (2008). The Anatomy of Prototypes: Prototypes as filters, prototypes as manifestations of design ideas. In *ACM Transactions on Computer-Human Interaction* (*TOCHI*), 15(2), 1-27.

Lynch, K. (1960). *The Image of the City*. Cambridge, MA: MIT Press.

Meng, L., Zipf, A., & Reichenbacher, T., (Eds.), (2005). *Map-based Mobile Services*. Berlin: Springer.

Mollerup, P. (2013). *Wayfinding > Wayshowing: Basic & Interactive*. Baden: Lars Müller.

Oksanen, J., Halkosaari, H.M., Sarjakoski, T., & Sarjakoski, L.T. (2014). A User Study of Experimental Maps for Outdoor Activities. *Cartographica: The International Journal for Geographic Information and Geovisualization*, 49(3), 188-201.

Porathe, T. (2008). Measuring the effectiveness of map design for route guidance: An experiment comparing electronic map display principles. *Information Design Journal,* 16(3), 190-201.

Reichenbacher, T. (2004). *Mobile Cartography - Adaptive Visualisation of Geographic Information on Mobile Devices*. Ph.D. thesis, Munich: Technical University of Munich.

Sáenz, M., & Sánchez, J. (2010). Indoor orientation and mobility for learners who are blind. *Studties in Health Technology Informatics*, 154, 165-170.

Smith, J. (2008). Interpretive Phenomenological Analysis. In Smith, P., (Ed.), *Qualitative Psychology: A Practical Guide to Research Methods*, 53-80. London: Sage.

Smith, J., Flowers, P., & Larkin, M. (2009). Interpretive Phenomenological Analysis: Theory, Method and Research. London: Sage.

Speake, J. (2015). 'I've got my Sat Nav, it's alright': Users' Attitudes towards, and Engagements with, Technologies of Navigation. *The Cartographic Journal*, 52(4), 345-355.

Steen, M. (2011). Tensions in human-centred design. *CoDesign*, 7(1), 45-60.

Taher, F., & Cheverst, K. (2011). Exploring user preferences for indoor navigation support through a combination of mobile and fixed displays. In Bylund , M. (Ed.) P*roceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services*, 201-210. New York: ACM.

Tashakkori, A., & Teddlie, C. (1998). *Mixed Methodology: Combining qualitative and quantitative approaches*. London: Sage.

van Hage, W., Stash, N., Wang, Y., & Aroyo, L. (2010). Finding your way through the Rijksmuseum with an adaptive mobile museum guide. In Davies, J.F., Bussler, C., & Studer, R., (Eds.), The Semantic Web: Research and Applications, 46-59. Berlin: Springer.

Wakkary, R., & Hatala, M. (2007). Situated Play in a Tangible Interface and Adaptive Audio Museum Guide. *Personal and Ubiquitous Computing*, 11(3), 171-191.

Walker, K. (2010). *Designing for Meaning Making in Museums: Visitor-constructed trails using mobile digital technologies*. Ph.D. thesis, London: University of London.

Wang, D., Park, S. & Fesenmaier, D.R., 2012. The role of smartphones in mediating the touristic experience. *Journal of Travel Research*, 51(4), 371-387.

Willis, K., Hölscher, C., Wilbertz, G., & Li, C., (2009). A comparison of spatial knowledge acquisition with maps and mobile maps. *Computers, Environment, and Urban Systems*. 33(2), 100-110.

Zimmerman, J., & Forlizzi, J. (2008). The Role of Design Artifacts in Design Theory Construction. *Artifact*, 2(1), 41-45.

Zimmerman, J., Stolterman, E., & Forlizzi, J. (2010). An Analysis and Critique of Research through Design: Towards a formalization of a research approach. In *Proceedings of the 8th ACM Conference on Designing Interactive Systems* (DIS ’10). New York: ACM.

Zipf, A., & Richter, K.F. (2002). Using focus maps to ease map reading. *Künstliche Intelligenz*, 4(2), 35-37.